$U_{GB} \rightarrow$ Unity gain Bandwidth.

$$A_D = -\frac{R_F}{R_1} V_{xy} \Rightarrow B = 1/A_D$$

$$A_D = \left(1+\frac{R_F}{R_1}\right)(V_{xy}) \Rightarrow B = 1/A_D$$

$$R_{OF} = \frac{R_O}{1+AB} \Rightarrow R_{OF} = \frac{R_O}{1+A/A_D}$$

$$f_1 = \frac{U_{GB}}{A_D}$$

Q.1) For a diff ampr in 2 opamp configun R_1 & R_3 are $= 680\,\Omega$, R_F & $R_2 = 6.8\,K\Omega$, $V_{y} = -2$ Vpp sinwave, $V_{x2} = 1.5$ V at frea 1 KHz then 741C find out the vltg gain, i/p resistance, o/p resistance, o/p Vltg for the ampr.

$\rightarrow$

$$A_D = \frac{-R_F}{R_1} V_{xy}$$

$$= \frac{6.8 \times 10^3}{680} = 10$$

$$= 1 + \frac{6.8 \times 10^3}{680} = 11$$

For close loop,

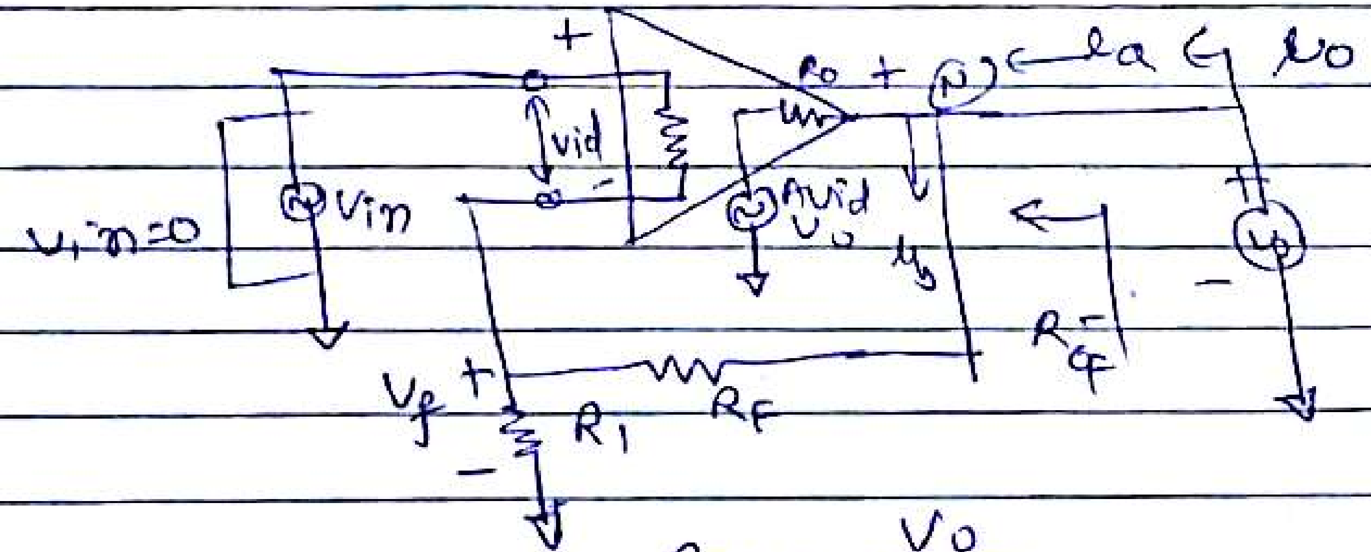
$$R_{IF} = \frac{V_{in}}{I_{in}} = \frac{V_{in}}{V_{id}/R_i} = \frac{V_{in}}{V_{id}/R_i}$$

$$V_{id} = \frac{V_0}{A} \quad \frac{V_{in}}{V_0/A} \Rightarrow \frac{V_0}{V_{in}} = \frac{A}{1+AB}$$

$$R_{IF} = R_I \frac{V_{in}}{V_0/A} = \cancel{A} R_i \times \frac{V_{in}}{A V_{in}/1+AB}$$

$$\boxed{R_{IF} = R_I (1+AB)}$$

* Output resistance with feedback :-



$$R_{OF} = \frac{V_0}{I_0}$$

KCL at Node N

$$I_0 = I_a + I_b$$

$(R_F + R_1) \parallel$ d R_{eff} R_0

$$V_0 - I_0 R_0 - AV_{id} = 0$$

$$I_0 = \frac{V_0 - AV_{id}}{R_0}$$

Saturation limit : ±14

o/p [redacted] come in +14 to -14 .

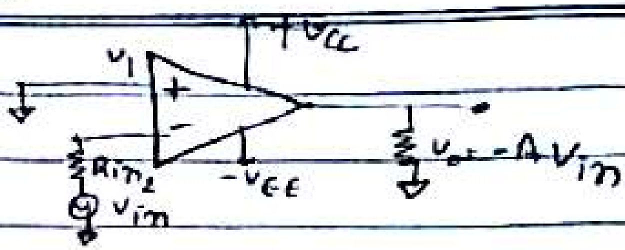
b/w

No.

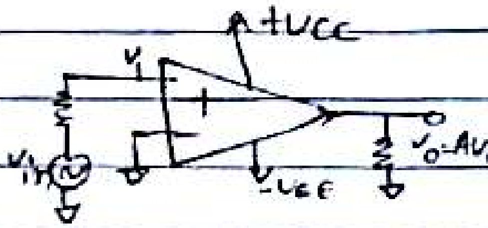
Date: / /

* Inverting ampl^r :-

— sign ⇒ o/p is 180° phase shift or reciprocal



* Non- inverting ampl^r :-



Q.1]

Determine the o/p vltg for open loop differential ampl^r if ⓐ $V_{in_1} = 5\,\mu V\,dc$ $\quad V_{in_2} = -7\,\mu V\,dc$

ⓑ $V_{in_1} = 10\,mV$ rms $\quad V_{in_2} = 20\,mV$ rms

opamp is a 741 with a following specifications - The gain of the opamp $A = 2\times10^5$, $R_{in} = 2\,M\Omega$, $R_o = 75\,\Omega$, $+V_{cc} = +15V$, $-V_{EE} = -15V$.

→ ~~Vin~~ R. $A = 2\times10^5$, $R_{in} = 2\,M\Omega$

• $R_o = 75\,\Omega$, $+V_{cc} = +15V$, $-V_{EE} = -15V$

$A = \dfrac{V_o}{V_{id}}$ ⇒ $V_{id} = V_1 - V_2$

∴ $R_{in} = 2\,M\Omega$

$\cancel{R_{in} = R_1 - R_o}$

$\cancel{2\times10^6 = R_1 - 75}$

$\cancel{R_1 = 2\times10^6 + 75 = 2.00\times10^6}$

$V_{id} = V_{in_1} - V_{in_2} = 10 - 20 = -10\,mV$

$A = \dfrac{V_o}{V_{id}} \Rightarrow 2\times10^5 = \dfrac{V_o}{-10} \Rightarrow V_o = 24$

IC

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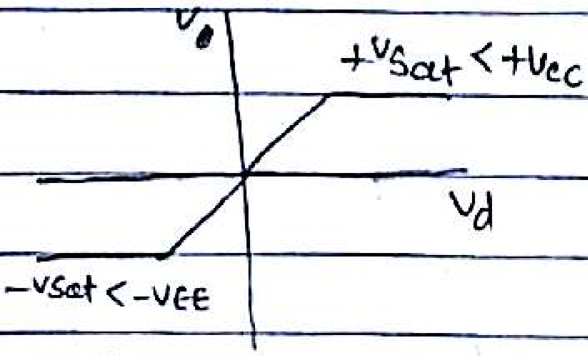
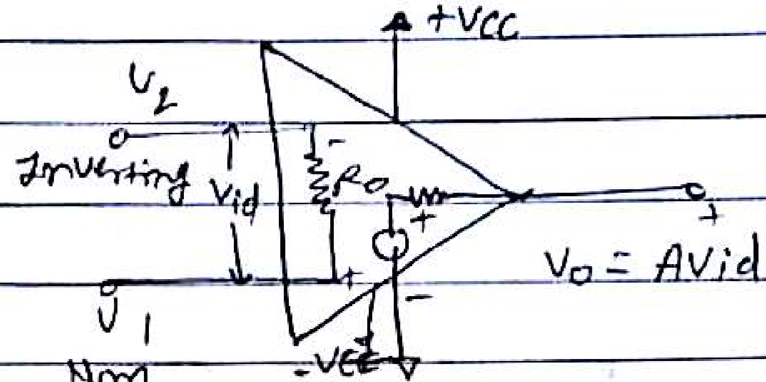
Friday

Eq. ckt of opamp :-





Ideal characteristic curve of op-amp

$$V_{id} = V_1 - V_2$$

$$V_0 - I_0R_0 - AV_{id} = 0$$

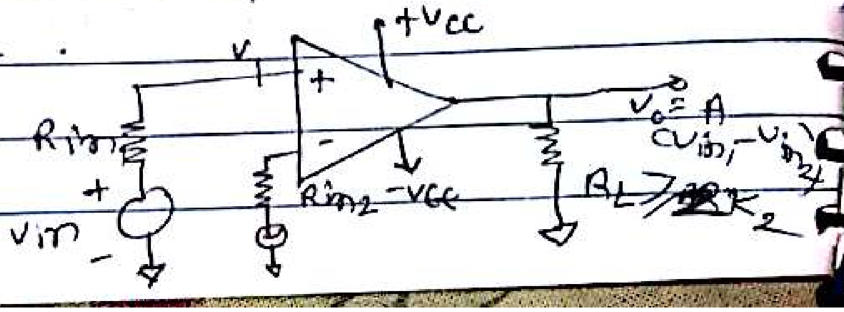
$$\boxed{V_0 = AV_{id}}$$

diff b/w inverting & non inverting ↑ the o/p also ↑

$V_0 = A V_{id} \Rightarrow \boxed{A = \frac{V_0}{V_{id}}} \rightarrow$ gain of the ampl^r.

Differential ampl^r :-

For amplific^n of AC as well DC we used diff. ampl^r.



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No.

Date: / /

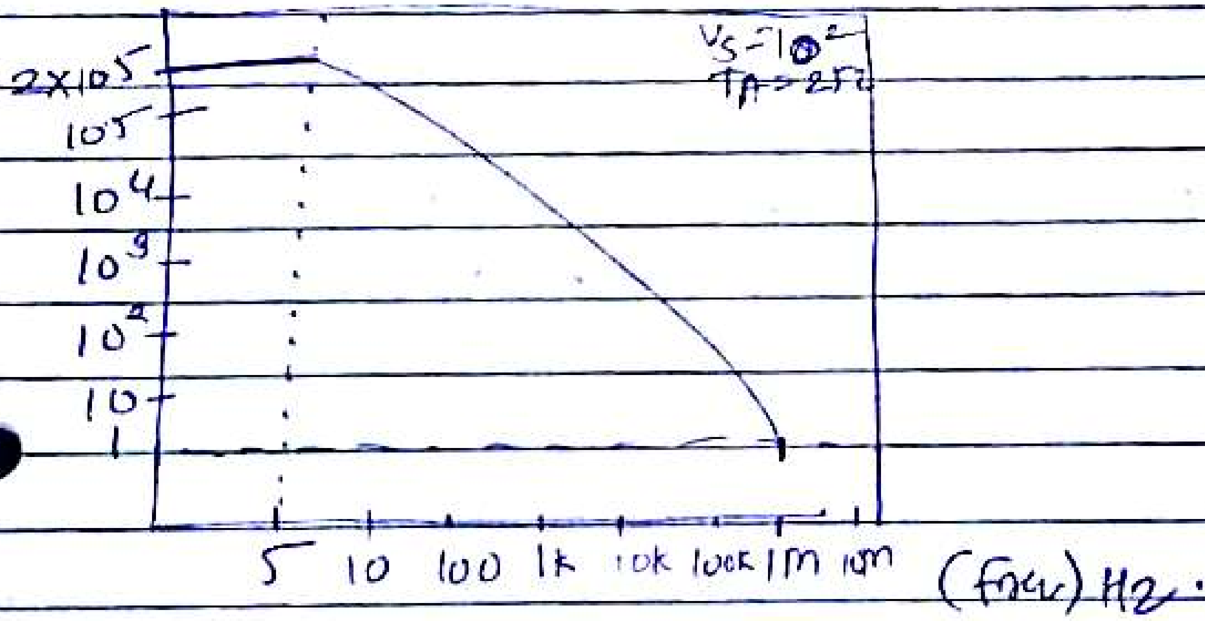
$v_{id} = v_1 - v_2 = 0 - v_f$ ∴ $i_o = \frac{v_o - A v_{id}}{R_o}$ — (1)

$v_{id} = v_1 - v_2 = 0 - v_f = \frac{-R_1}{R_1 + R_F} = -Bv_o$

$-Bv_o$ put in (1) $i_o = \frac{v_o + ABv_o}{R_o}$

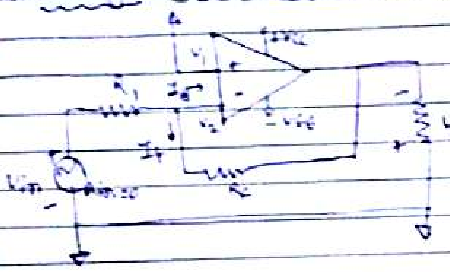
$R_{oF} = v_o / i_o$ ∴ $R_{oF} = \frac{v_o}{2\,(1+AB)/R_o}$

Bandwidth with Feedback :-

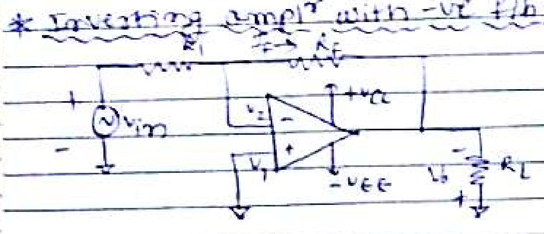


The gain BW product is defined for opamp 741 which is product ~~for~~ BW & gain. so for 741 amp we have one breath freq. below unity gain BW. The breath freq defined as the freq. at which gain is 3dB down from the value at 0 Hz.

* Voltage shunt Feedback ampl^r :-



* Inverting ampl^r with -ve f/b Vlg shunt :-



close loop gain of inverting ampl^r

$I_{in} = I_B + I_F$

R_i is very large so ignore I_B

$I_{in} = I_F$

$$\frac{V_{in} - V_2}{R_1} = \frac{V_2 - V_0}{R_F} \quad \text{--- (I)}$$

$V_0 = A(V_1 - V_2)$

$V_1 = 0 \qquad V_0 = A(0 - V_2) \Rightarrow V_2 = -\frac{V_0}{A}$

putting the value of $V_2 = -V_0/A$ in eq^n (I)

$$\frac{V_{in} + V_0/A}{R_1} = \frac{-V_0/A - V_0}{R_F}$$

$$A_F = \frac{V_0}{V_{in}} = \frac{-AR_F}{R_1 + R_F + AR_1} \quad \text{exact}$$

$AR_1 >>> R_1 + R_F$

$$A_F = \frac{-AR_F}{AR_1} \Rightarrow \boxed{A_F = \frac{-R_F}{R_1}} \quad \text{Ideal.}$$

$A_F < 1 \rightarrow$ possible in inverting ampl^r

$A_F < 1 \rightarrow$ Not possible in non inverting ampl

$$A_F = \frac{A\frac{R_F}{R_1 + R_F}}{\frac{R_1 + R_F}{R_1 + R_F} + \frac{AR_1}{R_1 + R_F}}$$

$$\boxed{A_F = \frac{AK}{1 + AB}} \qquad \because K = \frac{R_F}{R_1 + R_F}, \quad \because B = \frac{R_1}{R_1 + R_F}$$

In the gain of the inverting ampl^r is the K times of non inverting ampl^r when, $K < 1$.

gain of the inverting ampl^r > gain of the non inverting ampl^r.

KPMG

No.

Date 28/07/17
Friday.

For a 741 opamp having the foll. Parameters connected to non inv amp. with the value of Rf & R_1 given.

$R_1 = 1K\Omega$, $Rf = 10k\Omega$, $A = 2\times10^5$,

$R_i = 2M\Omega$, $R_0 = 75\Omega$, $f_0 = 5Hz$,

Supply $V_0H = \pm 15V$

To find A_F, R_{if}, R_{of}, $f_1 = V_{OOT}$

$$A_f = \frac{A}{1+AB} = \frac{2\times10^5}{1+2\times10^5}$$

$$A_F = \frac{A(R_1+R_F)}{R_1+R_F+AR_1}$$

$$= \frac{(2\times10^5)(1\times10^3 + 10\times10^3)}{1\times10^3 + 10\times10^3 + (2\times10^5)(1\times10^3)}$$

$$= 10.99$$

$$B = \frac{R_1}{R_1+R_F} = 0.090$$

$$R_{if} = R_i(1+AB) = 1.0$$

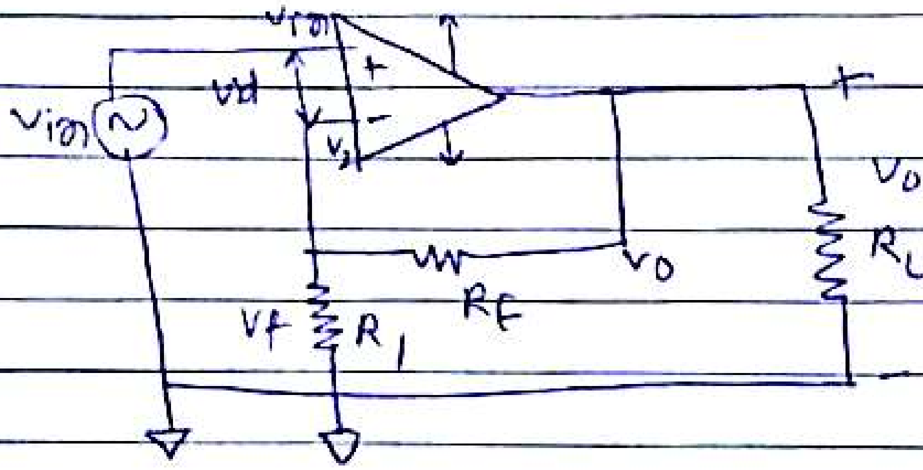
$$R_{of} = \frac{R_0}{1+AB} = \frac{75}{1} = 75\Omega$$

$$f_i = f_0(1+AB) = 5Hz$$

$$V_{OOT} = \frac{V_0}{1+AB} = \frac{13}{(1+AB)} = 13V.$$

27/07/17
Thursday

* Opamp with negative feedback:-
Non inverting configur^n (voltage series)



* O/P loop is only suit to low freq.
o/l vltg range ↑ o/p will clipped (limit)
distortion in sig.
i.e. why O/P loop to close loop goes.

* why we used -ve f/b ?
→ The f/b is subtract from the i/p vltg.

$V_o = A \times V_{id} = A(V_1 - V_2)$

$V_{in} - V_{id} - V_f = 0$ ... (by applying KVL)

$V_{id} = V_{in} - V_f$

to reduce gain we used

-ve f/b purpose → to control gain &
BW is increases.,

o/p impedance : Non inverting ampl^r > Inverting ampl^r

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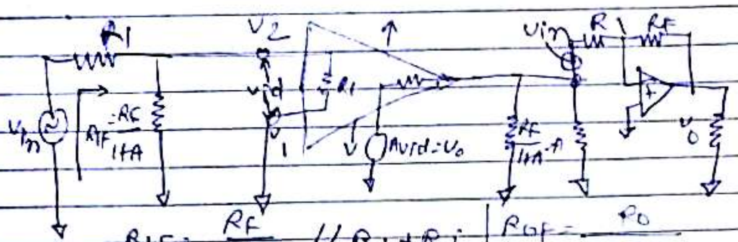
$$\boxed{A_F = \frac{-K}{B}}$$

Diff. of i/p sig is ideally zero :
$V_{id} \approx 0 \Rightarrow V_1 - V_2 = 0$



$$R_{IF} = \frac{R_F}{1+A} \,//\, R_1 + R_i$$

$$R_{OF} = \frac{R_o}{1+AB}$$

$$R_{IF} \approx R_i$$

$$R_{iF} = R_i(1+AB)$$

$$\frac{R_F}{1+A} + \frac{R_F A}{1+A} = R_F$$

The i/p impedance of non inverting f/b ampl^r > inverting f/b ampl^r
o/p resist is same exactly as the non inverting ampl^r.

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Date 03/08/17 Thursday.

* Bandwidth with feedback :-

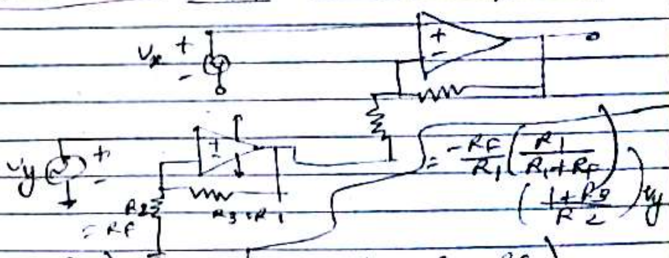
$f_F = f_o(1+AB)$, $UGB = f_o A$

$\boxed{f_o = \frac{UGB}{A_F}}$ for non inverting

$\boxed{f_F = \frac{UGB\,K}{A_F}}$ → Inverting.

o/p offset vltg is same.

Differential ampl^r with 2 opamps :-



$$= \frac{-R_F}{R_1}\left(\frac{R_1}{R_1+R_F}\right)\left(1+\frac{R_3}{R_2}\right)V_y$$

$V_o = \left(1+\frac{R_F}{R_1}\right)V_{in}$

$V_2 = \left(1+\frac{R_3}{R_2}\right)V_y$

$V_{o2} = \left(1+\frac{R_F}{R_1}\right)V_x$ — (1)

$V_o = \left(1+\frac{R_F}{R_1}\right)V_y$

$V_{o1} = \frac{-R_F}{R_1} V_2$

$= -\frac{R_F}{R_1}\left(1+\frac{R_3}{R_2}\right)V_y$

$V_{o1} + V_{o2} = \left(1+\frac{R_F}{R_1}\right)V_x$

$- \frac{R_F}{R_1}\left(1+\frac{R_3}{R_2}\right)V_y$

$= \left(1+\frac{R_F}{R_1}\right)(V_x - V_y)$

$UGB = Af_0$ —① $UGB = A_f + f$ —②

$Af_0 = A_F \cdot f_F$ —③ $\Rightarrow f_F = \frac{A f_0}{A_F}$. $A_F = \frac{A}{1+AB}$

$f_F = \frac{A f_0}{\frac{A}{1+AB}} \Rightarrow \boxed{f_F = (1+AB) f_0}$

* Voltage series non inverting conf. (-ve f/b)

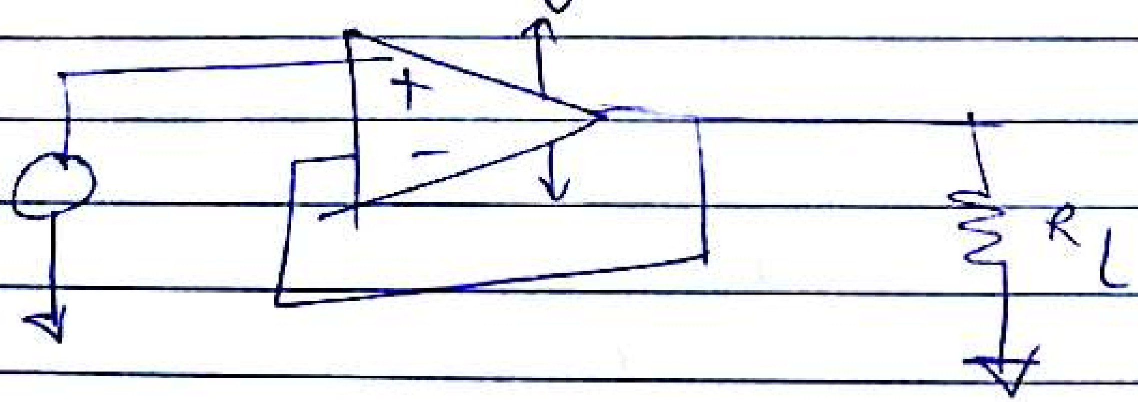
1) $A_F = \frac{A(R_1+R_F)}{R_1+R_F+AR_1}$ exact $A_F = \frac{A}{1+AB}$, $B = \frac{1}{A_F}$

ideal $= \left(1+\frac{R_F}{R_1}\right)$ $B = \frac{R_1}{R_1+R_F} = \frac{V_f}{V_0}$

2) $R_{iF} = R_i(1+AB)$ 4) $f_{IF} = f_0(1+AB)$

3) $R_{oF} = \frac{R_0}{1+AB}$ 5) $V_{OOTf} = \pm \frac{V_{OOL}}{1+AB}$

Q.1) How the vltg follower can be designed from vltg series non inverting conf. with -ve f/b.



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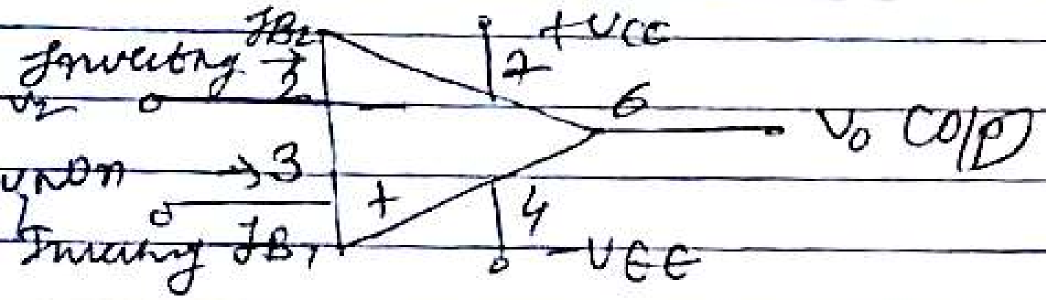
स्वेता SHWETA

20/07/17
thursday.

* Electrical characteristic of op-amp:-



$V_{id} = V_1 - V_2$

$V = A \times V_{id}$

$V_0 = A V_{id}$

* I/P bias current: $= \frac{I_{B1} + I_{B2}}{2}$

$CMRR = \frac{A_d}{A_{cm}}$ → difference gain
→ common mode gain

A_d → large sig gain.

A_{cm} → volume very small

* CMRR → good matching.
* CMRR should be very high.

A → O/P loop conf. B → gain.
Af → close loop conf.

2 → wed
No. → Tue
31 → mon [illegible]
Date [illegible]
29 → Sat
28 → Fri

$\frac{V_f}{V_0}$ → f/b gain of the ckt

$$V_0 = A \times V_{id} = A(V_1 - V_2) = A\left(V_{in} - \frac{R_1}{R_1+R_F} V_0\right)$$

$$\frac{V_0}{V_{in}} = A_F = \frac{A(R_1+R_F)}{R_1+R_F+AR_1}$$

... (If $AR_1 >>> R_1+R_F$)

$\therefore =$ [illegible]

$$\boxed{A_F = 1 + \frac{R_F}{R_1}}$$

. opamp

Overall gain of non inverting [illegible] with -ve f/b.

$$A_F = \frac{A(R_1+R_F)}{R_1+R_F+AR_1}$$

Just divide num & deno by R_1+R_F

$$A_F = \frac{A\frac{(R_1+R_F)}{(R_1+R_F)}}{\frac{R_1+R_F}{R_1+R_F} + \frac{AR_1}{R_1+R_F}}$$

$$\boxed{A_F = \frac{A}{1+AB}}$$

** Difference input voltage ideally zero

$V_1 = V_{in}$ $\qquad$ $V_{id} = V_1 - V_2 = 0$

$V_2 = V_f = \frac{R_1}{R_1+R_1}$ $\qquad$ $V_0 = V_{in}$